CLAIMS

The embodiments of an invention in which an exclusive property or right is claimed are defined as follows:

1. A method for analyzing the performance of a mechanical system wherein light is directed from at least one light source to encoded portions of two rotating members associated with said mechanical system, said method comprising the steps of:

reflecting a portion of said light to at least one encoded portion of said rotating members;

detecting a reflected portion of said light; and

recovering information from said reflected portion of said light, wherein said reflected portion of said light contains performance characteristic data of said mechanical system.

2. The method of claim 1 further comprising the step of:

configuring said at least one light source as a vertical cavity surface emitting laser (VCSEL) unit.

3. The method of claim 1 wherein said at least one encoded portion of said rotating members comprises two identical bar codes.

4. The method of claim 1 wherein said at least one encoded portion of said rotating members comprises a measuring feature formed along circumferential edges of said rotating members.

5. The method of claim 4 wherein said measuring feature formed along circumferential edges of said rotating members comprises at least one optical encoder for encoding performance characteristic data of said mechanical system.

6. The method of claim 5 further comprising the step of:

configuring at least one measuring feature to form a plurality of measuring features comprising a vernier for measuring movement within said mechanical system.

7. The method of claim 1 further comprising the step of:

shaping said at least one encoded portion of said rotating member to increase reflection of said reflected light in a particular direction.

8. The method of claim 1 further comprising the step of:

reflecting light beams from at least one encoded portion of said rotating members to interact with at least one other encoded portion of said rotating members to form Moirè fringes on a sensor plate.

9. The method of claim 1 further comprising the step of:

assessing the reliability of said mechanical system utilizing said performance characteristic data of said mechanical system.

10. The method of claim 9 further comprising the steps of:

generating an electrical feedback signal from recovered information containing said performance characteristic data of said mechanical system; and

providing said electrical feedback signal to an input of said mechanical system, thereby improving said performance characteristic data of said mechanical system.

11. An apparatus for analyzing the performance of a mechanical system having a rotating member therein, said apparatus comprising:

directing mechanism for directing light from a light source in order to intercept an encoded portion of said rotating member;

reflecting mechanism for reflecting a portion of said light from said encoded portion of said rotating member; and

detecting mechanism for detecting a reflected portion of said light to recover performance data maintained therein, wherein said performance data contains performance characteristics of said mechanical system.

12. The apparatus of claim 11 further comprising:

recovery mechanism for recovering said performance data.

13. The apparatus of claim 1 further comprising:

reflecting mechanism for reflecting a portion of said light through said encoded portion of said rotating member.

14. The apparatus of claim 11 wherein said light source comprises at least one Vertical Cavity Surface Emitting Laser (VCSEL) unit.

15. The apparatus of claim 11 wherein said light source comprises at least two identical Vertical Cavity Surface Emitting (VCSEL) units.

16. The apparatus of claim 11 wherein said encoded portion of said rotating member comprises a bar code.

17. An apparatus for detecting the relative motion between two rotating members in a mechanical system having two identical light sources for generating two identical light beams, said apparatus comprising:

at least one first reflector located on a first rotating member positioned such that the reflection of a first light beam forms an encoded portion of said first rotating member;

at least one second reflector located on a second rotating member positioned such that the reflection of a second light beam forms an encoded portion of said second rotating member; and

at least one detector that detects Moirè fringes formed as a result of the interaction of images from said first and second encoded portions of said first

and second rotating members, wherein said detector is located proximate to said mechanical system.

18. The apparatus of claim 17 further comprising:

a sensor that analyzes a signal from said detection mechanism, thereby monitoring motion associated with said Moirè fringes, wherein said sensor is located proximate to said mechanical system.

19. The apparatus of claim 18 further comprising:

at least two collimating lenses located in an optical path of said mechanical system, wherein said collimating lenses render said light beams from said light sources into highly collimated parallel light beams; and

at least two optical elements that operate on said light beams after passing through said at least two collimating lenses, thereby directing said light beams to intercept said encoded portions on said first and second rotating members.

20. The apparatus of claim 17 wherein said light sources comprise at least two Vertical Cavity Surface-Emitting Laser (VCSEL) units.

21. The apparatus of claim 21 wherein light beams from said Vertical Cavity Surface-Emitting Laser (VCSEL) units are rendered highly collimated by convex collimating lenses before said light beams intercept encoded portions of said first and second rotating members.

22. The apparatus of claim 21 wherein said encoded portions comprise:

a transparent polymer film having parallel lines of opaque bar code imprinted on an upper surface of said transparent polymer film; and

wherein said parallel lines are spaced evenly, thereby forming a gap therebetween, wherein a width associated with said gap is identical to a width of

said parallel lines, such that said transparent polymer film is adhesively attached to a rotating member; and

wherein said parallel lines are positioned at angle in relation to an axis of rotation of said rotating members.

23. The apparatus of claim 22 wherein:

said transparent polymer film comprises a bar code when adhered to a rotating disk; and

wherein said bar code is adhered along a circumferential edge of said rotating member.

24. The apparatus of claim 17 wherein:

said first light beam intercepts said first encoded portion of said first rotating member at an angle of incidence of "a"; and

said second light beam, identical to said first light beam, intercepts said second encoded portion of said second rotating member at an angle of incidence of "a";

wherein said first light beam carries an image of said bar code after being reflected from said first encoded portion of said first rotating member; and

wherein said second light beam carries an image of said bar code after being reflected off said second encoded portion of said second rotating member.

25. The apparatus of claim 24 wherein an image from said first encoded surface interacts with an image of said second encoded surface after said light beams are reflected off said first and second rotating surfaces to produce Moirè fringes.

26. The apparatus of claim 25 wherein Moirè fringes are observed on a sensor plate.

27. The apparatus of claim 26 wherein said sensor plate is located at a Talbot distance from a point where said reflected light beams originate from said encoded surface of said first and second rotating members.

28. The apparatus of claim 26 wherein said detection mechanism is located on said sensor plate.

29. The apparatus of claim 17 wherein said encoded portion of said rotating member is shaped to increase said reflected light in a particular direction.

30. The apparatus of claim 17 wherein said encoded portion of a rotating member is shaped to form an optical encoder for encoding data representing performance characteristics of said mechanical system.

31. The apparatus of claim 17 wherein said encoded portion of a rotating member is provided as a vernier on said rotating member to increase accuracy for sensing motion thereof.

32. The apparatus of claim 17 wherein said encoded portion of said rotating member comprises measuring features recessed into a surface or edge of said rotating member.